60°. The variations in the annual mean temperature from year to year rarely exceed 3°, and are often less than 1°. The following table shows the mean temperature of each division by seasons:

Divisions.	Spring.	Summer.	Autumn.	Winter.
	°	°	°	°
Northwestern plateau	27.7	51.8	74.5	53.6
Northeastern plain	30.6	53.5	75.3	55.1
Southwestern lowlands	31.9	54.3	75.7	56.1
Ozark plateau	34.7	55.1	74.8	56.2
Southeastern lowlands	37.3	58.0	76.7	58.3
State	32.4	54.5	75.3	55.9

The warmest month of the year is July, with a mean temperature for the State of 77°, and the coldest is January, with a mean temperature of 29.8°. During the months of June, July, August, and September the temperature occasionally rises to 95°, but does not often exceed 100°. During the winter months the temperature sometimes falls to 5° or 10° below zero, but temperatures of 20° below zero are of rare occurrence. The average number of days during the year with maximum temperature above 90° is 20, and the average number with minimum temperature below 32° ranges from about 75 in the southern to 110 in the northern portion of the State. During the winter cold waves occasionally sweep over the State which cause falls in the temperature of from 40° to 60° in twenty-four hours, but periods of extreme cold are usually of short duration, as are also periods of extreme heat in summer.

The average date of the last killing frost in spring and the first in autumn, as computed from the records of the several Weather Bureau stations, is as follows:

Station.	Last in spring.	First in autumn.	Length of season.
			Days.
Keokuk, Iowa	April 11	October 13	184
Hannibal, Mo	April 13	October 16	185
St. Louis, Mo	April 10	October 31	203
Columbia, Mo	April 13	October 14	183
Kansas City, Mo	April 8	October 16	190
Springfield, Mo	April 16	October 13	180
Cairo, Ill	March 29	October 25	209

The average annual precipitation for each division and for the State, compared from all records to the end of 1898, is as follows: Northwestern plateau, 36.33 inches; northeastern plain, 38.41 inches; southwestern lowlands, 39.24 inches; Ozark plateau, 43.73 inches; southeastern lowlands, 46.36 inches; and for the State, 40.81 inches. The wettest months are May and June, the average precipitation for the State for those months being 5.23 and 4.95 inches, respectively, and the driest are February and October, with an average for the State of 2.33 and 2.36 inches, respectively. The following table shows the average precipitation for each division by seasons:

Division.	Spring.	Summer.	Autumn.	Winter.
	Inches.	*Inches.*	*Inches.*	*Inches.*
Northwestern plateau	10.74	13.62	7.32	4.65
Northeastern plain	11.58	11.87	8.45	6.51
Southwestern lowlands	13.44	12.59	7.79	6.42
Ozark plateau	14.00	13.75	8.89	8.09
Southeastern lowlands	14.53	11.86	9.90	10.57
State	12.65	13.44	8.47	7.25

Of the years from 1888 to 1899, inclusive, the wettest was 1898, with an average for the State of 53.67 inches, and the driest was 1894, with an average of 33.18 inches. Rainfalls of from 2 to 3 inches in twenty-four consecutive hours occur in some portion of the State during nearly every month of the year, but falls of more than 4 inches in twenty-four hours are comparatively rare.

From November to March, inclusive, the precipitation is usually general in character, but during the summer months the greater part occurs in the form of local showers.

The average seasonal snowfall ranges from about 10 inches in the southeastern to about 25 inches in the northwestern portion of the State.

The prevailing winds are southerly, although during the winter season northwesterly winds prevail a considerable part of the time. The average hourly wind velocity ranges from 5 to 10 miles during the summer, and from 8 to 12 miles during the winter months.

The average cloudiness ranges from 35 to 50 per cent during the summer and autumn, and from 50 to 55 per cent during the winter and spring. The average number of rainy days (days on which .01 of an inch or more of precipitation falls) is 9 in January and February, 10 in March, 11 in April, 13 in May, 11 in June, 9 in July, 8 in August and September, 7 in October, and 8 in November and December.

The mean annual relative humidity is 72 per cent.

CLIMATOLOGY OF ST. KITTS.

By WILLIAM H. ALEXANDER, Observer, Weather Bureau, dated November, 29, 1899.

Discovered by and named for the peerless prince of mariners, the little island of St. Christopher, or as more generally known St. Kitts, first appears on the pages of written history in 1493, possessed of a charm which becomes more and more intense as we follow its varied history through subsequent years. Believing that this history could be made to pay rich tribute to the subject of meteorology, the writer began and is diligently pursuing an investigation of all available records of whatever character which might throw some light upon any phase of this subject. The present memoir gives some of the results of these labors.

Because of the intimate relation between the topography of any place and many phases of its meteorological history, a clear understanding of its topography is highly important, consequently I begin this discussion with a few words on this point.

The island lies in north latitude 17° 20′ and west longitude 65° 45′. The area of the main body resembles a long oval from the southeastern end of which runs a narrow neck, gradually expanding into a small knob. The total length of the island is 23 miles, and the breadth of the main body is about 5 miles; that of the knob or peninsula, about 2 miles. The breadth of the neck varies from half a mile to a mile. The total area of the island is 68 square miles.

The central part of the main body is occupied by a range of lofty, rugged mountains which traverses it from southeast to northwest, attaining its greatest height at Mount Misery, with a secondary culminating point near the southeastern end of the island, and between these two there is a decided depression. Mount Misery is about 4,100 feet high, and the secondary elevation about 3,200 feet. The mountains appear to be crowded together and are intersected by rocky precipices. From the secondary culmination a range of hills branches off describing almost a semi-circle, and forming the spacious and fertile valley or plane in which Basséterre is situated. Immediately beyond the hills on the southeast is the narrowest part of the neck, which at this point is perfectly flat, but as it expands it rises into conical hills which traverse the knob or peninsula in almost every direction. In one spot, however, the hills recede from the sea, forming a basin within which is a salt pond about 2 miles in circumference.

The circle of land formed by the skirts and lower slopes of the mountains of the main body of the island and the valley of Basseterre, constitute nearly the whole of the arable

and cultivated portion of the island: These tracts of land are covered with sugar plantations and dotted over in every direction with homesteads, mills, and laborers' villages. The higher slopes of the mountains are clothed with short grass affording excellent pasturage, while their summits are crowned with dense woods.

That the island is of igneous origin is established beyond question by the immense layers of volcanic ashes found in every section. At Sandy Point, for instance, there are alternate layers of these ashes and soil for a depth of 75 feet on a substratum of gravel. The soil is a dark grey loam, very porous, and is considered the very best compost in the West Indies for the production of sugar. Clay is found in considerable quantities in the high or mountain lands, while the low lands are quite deficient in it.

The climate, speaking in a general way, is about what one might reasonably expect of a tropical island of the size and elevation of St. Kitts—dry and healthful, tempered and purified by the electric storms and hurricanes to which it is subject because of its position. The bracing qualities of the atmosphere are portrayed in the general good health of the inhabitants. The mornings and evenings of the hottest days are agreeably cool. The coldest months are January and February, the warmest, August.

Referring to the instruments used in securing the tabulated data herewith, it ought, perhaps, to be stated that the barometer was a standard mercurial, and the thermometer one of the best obtainable at the time. As to whether or not any corrections were made in the readings of the barometer from 1856 to 1882, inclusive, nothing is known; nor can the exposure of the thermometer be given; but the readings from 1892 to 1899 were reduced to sea level. It is believed that all the thermometer readings are too high, due to imperfect exposure, but granting that the instruments were not up to the requirements of to-day and that the exposure was not according to prescribed regulations, yet it must be admitted that there is a value in the data not to be despised. The records from 1856 to 1882, inclusive, were taken from the same instruments and by the same person; those from 1892 to August, 1898, were from the same set of instruments and by the same observer; while those from September, 1898, to October, 1899, are from the United States Weather Bureau instruments. The data must therefore have a comparative value worthy of the consideration.

Barometric pressures.—The data contained in Table 1, covering a period of thirty-four years and ten months, gives as the normal barometric mean for the year, 29.97 inches. By reference to figs. 1 and 2 it may be readily seen how slight are the departures and how small the range of the monthly means from this normal under usual conditions. The average range of the barometric pressure for the year is only .086 inch. Fig. 2 shows that the greatest departure above the normal occurs in February and June, and the greatest departure below the normal occurs in October and November, while the barometric conditions are most nearly normal in May, August, and December. That a slight or sudden disturbance beyond the narrow limits of the normal in the barometric gradients portend disastrous consequences is a well recognized fact, and the vigilance with which the people here watch "the glass" is not surprising.

TABLE 1.—*Showing the average monthly barometric pressure and temperature for a period of thirty-five years and total rainfall for each month for a period of forty-four years at Basseterre, St. Kitts, W. I.*

Year.	January.			February.			March.			April.			May.			June.		
	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.
	Ins.	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*
1856	30.03	81.0	2.40	30.02	80.7	2.40	30.03	81.1	4.70	30.01	81.9	4.60	30.01	83.4	1.85	30.03	83.5	4.40
1857	30.03	77.5	3.65	29.98	76.7	3.55	30.01	77.7	2.45	29.98	79.6	3.15	29.98	78.4	5.90	30.01	81.2	4.60
1858	30.02	78.3	1.90	30.03	80.2	1.90	30.00	79.8	2.90	30.00	79.7	4.30	30.00	80.6	3.50	30.02	81.1	4.90
1859	30.02	76.5	3.90	30.04	76.0	3.80	30.03	77.4	0.20	30.02	79.7	2.70	29.97	80.8	5.40	30.02	81.0	2.90
1860	30.04	80.0	2.10	30.04	79.1	1.30	29.99	80.0	3.80	29.98	81.3	3.20	30.01	82.1	0.70	30.01	83.8	3.40
1861	30.01	77.4	2.90	29.99	78.3	2.00	29.97	78.5	2.15	29.95	78.9	15.10	29.96	80.4	4.50	30.00	80.7	6.50
1862	29.98	78.0	1.15	30.03	76.8	2.15	30.01	78.2	1.20	29.98	79.0	4.60	29.97	81.0	5.40	29.99	81.5	2.40
1863	29.98	76.2	2.10	30.04	76.1	1.50	29.99	77.9	1.10	29.97	78.3	2.45	30.01	80.8	2.30	30.04	81.3	2.15
1864	30.03	78.1	3.10	30.01	76.1	0.50	29.98	77.8	2.10	29.99	80.1	0.45	29.93	80.4	1.30	30.03	81.7	3.15
1865	30.01	80.4	2.80	30.00	79.3	1.45	30.02	78.1	0.50	30.02	80.8	1.20	29.99	82.4	6.80	30.03	82.7	7.80
1866	30.02	77.0	5.95	30.02	77.1	1.60	29.98	77.0	2.90	29.99	78.8	3.25	29.98	81.0	6.00	30.02	82.1	4.90
1867	30.01	77.1	1.75	30.01	76.2	1.95	29.99	78.0	1.90	29.92	79.6	2.30	29.92	81.8	8.10	29.98	82.2	6.35
1868	30.01	79.4	3.45	29.97	79.3	1.10	29.96	79.1	3.60	30.02	80.1	0.65	29.96	81.2	1.15	30.00	84.0	0.80
1869	30.00	79.2	1.40	29.99	79.1	0.45	29.98	78.5	1.75	29.97	81.7	0.70	29.96	83.3	1.50	30 00	83.9	3.40
1870	29.97	77.9	3.50	29.97	79.2	1.60	29.94	79.2	2.85	29.95	79.8	2.95	29.96	82.0	2.60	29.94	81.8	5.75
1871	29.93	78.1	5.75	29.94	78.4	2.45	29.96	78.4	2.10	29.90	80.7	7.10	29.94	81.8	2.80	29.98	83.3	1.65
1872	29.95	80.0	1.00	29.95	78.9	2.30	29.94	80.4	1.05	29.92	81.4	1.45	29.94	83.3	1.15	29.98	83.0	1.65
1873	29.96	77.9	6.90	30.00	78.0	0.80	29.98	78.4	4.20	29.98	80.5	2.70	29.96	81.7	3.40	30.00	83.0	0.90
1874	29.95	78.7	1.90	29.94	78.6	2.45	29.95	79.7	2.90	29.98	79.3	2.05	29.93	81.9	2.40	29.98	83.8	1.95
1875	30.00	78.7	2.95	30.03	78.0	1.20	29.99	78.7	2.95	29.97	78.8	0.40	29.97	80.2	0.75	30.00	82.4	1.60
1876	29.96	78.3	2.65	29.97	78.4	2.10	29.95	77.8	2.20	29.93	80.1	10.45	29.93	81.3	8.80	29.98	83.4	4.05
1877	30.01	80.0	2.30	29.95	79.1	2.45	29.96	83.1	1.45	29.92	82.4	6.05	29.92	84.1	0.65	29.97	83.6	9.00
1878	29.99	80.3	8.50	29.98	82.0	5.00	29.98	81.7	2.60	29.93	82.5	4.15	29.97	84.1	10.95	30.01	82.1	3.20
1879	30.01	79.4	3.80	29.99	81.0	2.45	29.97	80.9	3.50	29.97	82.0	10.20	29.92	82.7	7.80	29.98	83.7	4.80
1880	29.92	78.0	37.05	30.01	78.2	0.50	30.02	79.4	1.90	30.03	79.9	4.30	29.99	81.5	4.10	30.03	84.7	1.65
1881	29.99	80.3	2.10	29.95	79.2	1.05	29.97	81.6	0.25	30.01	83.7	1.15	29.93	83.7	8.30	30.00	85.2	7.65
1882	30.03	79.6	0.70	30.05	79.3	1.00	30.03	80.3	0.55	30.00	82.2	0.00	30.00	83.2	0.60	30.03	85.1	2.85
1883	.....	.....	3.25	.....	.....	4.75	.....	.....	1.80	.....	.....	5.85	.....	.....	4.48	.....	.....	4.65
1884	.....	.....	1.64	.....	.....	2.18	.....	.....	3.81	.....	.....	0.51	.....	.....	5.54	.....	.....	3.69
1885	.....	.....	2.44	.....	.....	1.19	.....	.....	2.77	.....	.....	2.14	.....	.....	1.09	.....	.....	3.37
1886	.....	.....	3.95	.....	.....	1.62	.....	.....	3.65	.....	.....	3.40	.....	.....	1.57	.....	.....	2.60
1887	.....	.....	1.52	.....	.....	0.46	.....	.....	0.91	.....	.....	0.60	.....	.....	7.10	.....	.....	7.25
1888	.....	.....	2.19	.....	.....	1.21	.....	.....	0.52	.....	.....	2.89	.....	.....	6.70	.....	.....	5.36
1889	.....	.....	1.35	.....	.....	4.25	.....	.....	2.46	.....	.....	8.85	.....	.....	7.74	.....	.....	9.02
1890	.....	.....	5.47	.....	.....	1.29	.....	.....	1.82	.....	.....	3.07	.....	.....	2.59	.....	.....	0.89
1891	.....	.....	3.21	.....	.....	1.41	.....	.....	0.01	.....	.....	1.21	.....	.....	1.38	.....	.....	2.88
1892	30.01	79.2	2.99	30.01	78.5	1.59	30.02	80.0	1.37	30.04	80.0	1.35	30.03	81.2	3.61	30.07	84.3	3.55
1893	29.98	80.0	0.49	30.01	77.3	3.08	30.00	77.2	0.95	30.00	78.3	2.59	28.97	79.9	6.57	30.00	81.1	3.61
1894	29 97	76.4	2.37	30.03	76.7	1.68	30.01	76.4	1.89	29.97	78.2	2.32	29.94	81.1	1.03	30.02	81.7	3.48
1895	29.97	76.7	3.53	29.98	77.4	1.53	30.00	78.7	0.77	29.99	82.1	0.81	29.99	79.4	10.77	30.03	82.3	2.66
1896	29.96	77.6	2.96	29.98	77.6	2.39	29.96	77.9	2.57	29.95	79.6	2.79	29.94	81.4	3.58	29.99	82.2	8.93
1897	29.96	78.1	1.33	30.01	78.8	1.49	29.96	79.0	2.64	29.96	81.4	2.21	29.94	79.8	8.50	29.99	82.2	3.79
1898	30.00	78.5	1.98	29.87	79.4	1.02	29.98	77.5	2.36	30.01	78.3	1.43	29.98	82.3	2.25	30.01	82.5	2.76
1899	30.02	75.2	3.86	30.09	75.5	1.21	30.04	75.2	1.00	30.01	77.5	2.34	30.03	79.5	0.53	30.03	80.2	3.57
Monthly means	29.99	78.1	3.66	30.00	78.3	1.89	29.99	78.9	2.07	29.98	80.2	3.32	29.97	81.5	4.18	30.01	82.6	4.00

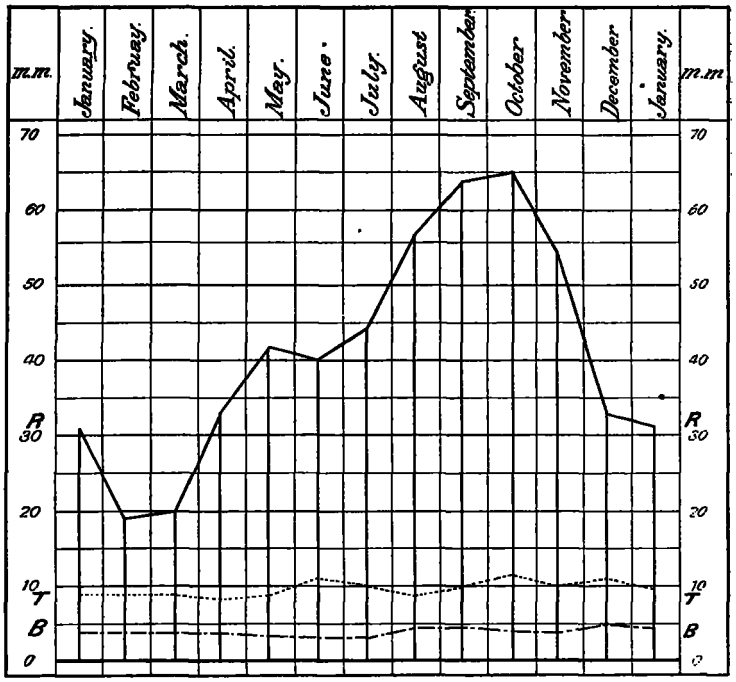

FIG. 1:—*R*. Graphic representation of the average monthly precipitation at Basseterre, St. Kitts, W. I., based upon forty-four years' record. *B*. Average range of barometric pressures for each month. *T*. Average range of temperature for each month. The ranges are based upon one year's record. Scale used in drawing these curves: 1 mm. equals 0.10 inch of rain, or a range of 1° in temperature, or a range of .02 inch in barometric pressure.

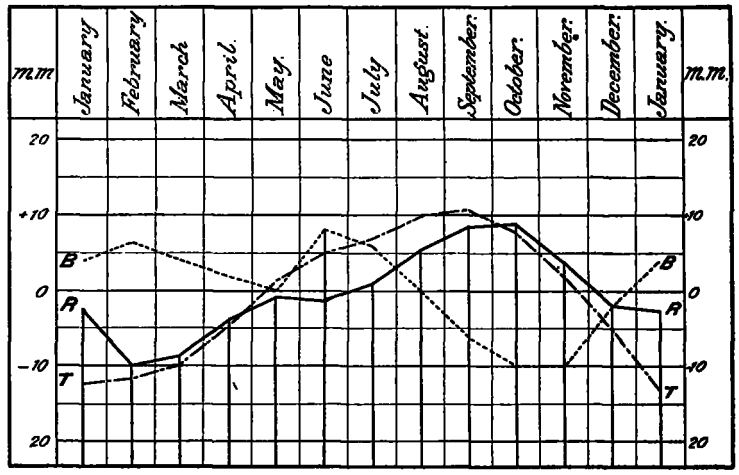

FIG. 2.—Graphic representation of the departures of the monthly means of barometric pressure, temperature, and rainfall. The zero line, or normal, corresponds to 29.97 inches of barometric pressure, *B;* and to 81.3° F. of temperature, *T;* and to 4.28 inches of rainfall, *R*. The mean barometric pressure and temperature are based on records extending over thirty-five years and the mean monthly rainfall on records extending over forty-four years.

Temperature (in Fahrenheit degrees).—Very much the same regularity noted in regard to barometric pressures characterize also the temperature changes, as will appear from a brief inspection of figs. 1, 2, and 3. The annual mean as obtained from the data contained in Table 1 is 81.3°, and that obtained from figures taken from the Richard barograph traces, covering one year, is 78.5°, a difference of a little less

TABLE 1.—*Showing the average monthly barometric pressure and temperature, etc.*—Continued.

Year.	July.			August.			September.			October.			November.			December.			For the year.		
	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Rainfall.	Barometer.	Temperature.	Total rainfall.
	Ins.	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*	*Ins.*	°	*Ins.*
1856	30.03	83.9	5.05	30.02	84.6	2.60	29.99	85.2	1.75	29.95	84.2	9.30	29.93	81.4	6.40	29.99	79.3	2.85	30.00	82.5	48.30
1857	30.01	78.8	6.25	30.08	79.6	3.60	29.99	80.2	8.80	29.96	79.5	7.60	29.95	82.0	6.80	30.00	80.0	5.80	29.99	79.3	62.15
1858	30.04	82.0	1.40	30.00	82.9	7.10	29.98	83.6	6.10	29.92	82.3	12.20	29.95	80.4	11.00	30.00	78.1	5.10	30.00	80.8	62.30
1859	30.03	81.2	5.10	30.00	81.9	7.70	29.96	82.9	10.60	29.94	81.9	8.00	29.98	80.1	3.10	29.97	78.1	3.10	30.00	79.8	56.50
1860	30.00	84.5	4.20	29.89	84.4	11.80	29.94	84.6	7.90	29.91	83.9	8.10	29.90	83.3	3.70	29.98	83.2	2.00	29.99	82.4	52.30
1861	30.01	81.8	4.95	29.98	83.4	5.25	29.95	83.7	4.90	29.88	82.6	23.40	29.91	80.5	7.10	29.94	79.1	4.35	29.96	80.4	83.10
1862	30.00	82.1	3.25	29.97	82.0	5.90	29.91	83.7	11.80	29.92	80.8	14.25	29.91	79.7	5.40	29.95	77.7	9.35	29.97	80.0	66.85
1863	30.04	81.1	2.00	30.04	82.1	1.90	29.98	82.5	4.05	29.94	82.2	10.00	29.94	80.0	5.05	29.97	77.5	2.55	29.99	79.7	37.15
1864	30.01	82.1	2.00	29.97	82.4	9.90	29.96	82.7	9.05	29.94	82.3	8.00	29.92	81.0	5.05	29.97	79.3	3.55	29.98	80.3	48.15
1865	30.04	84.4	8.55	29.96	84.7	3.15	29.95	84.4	5.85	29.94	83.4	1.35	29.94	82.1	7.50	29.98	79.1	4.05	29.99	81.8	51.00
1866	30.01	82.5	3.20	29.97	83.5	2.85	29.95	83.4	4.95	29.91	82.8	8.40	29.90	81.4	2.10	29.97	78.7	2.65	29.98	80.4	48.75
1867	29.99	82.9	3.65	29.97	83.5	3.55	29.96	83.5	4.05	29.90	82.6	3.35	29.92	81.9	6.85	29.97	79.5	4.05	29.97	80.7	47.85
1868	29.97	83.8	2.95	29.97	84.6	2.45	29.91	83.9	10.05	29.89	84.3	5.85	29.91	83.1	4.90	30.01	81.9	3.05	29.96	82.0	40.00
1869	29.99	84.0	3.95	29.96	85.0	4.30	29.90	83.2	9.75	29.88	84.1	8.75	29.90	82.5	5.40	29.88	81.5	1.30	29.95	82.2	42.65
1870	29.98	82.2	6.65	29.89	83.6	8.45	29.99	84.6	4.35	29.87	83.1	7.10	29.88	82.0	5.60	29.92	79.9	9.60	29.93	81.3	61.00
1871	29.95	83.2	3.85	29.91	83.5	12.00	29.90	84.1	3.80	29.87	83.0	7.80	29.87	82.3	2.75	29.97	80.3	3.95	29.93	81.4	56.00
1872	29.97	83.0	4.05	29.93	84.5	4.35	29.88	83.6	15.15	29.89	84.6	4.95	29.89	81.5	6.20	29.94	80.8	2.55	29.93	82.1	45.85
1873	29.98	84.0	1.10	29.94	84.2	3.70	29.92	83.7	7.60	29.89	83.6	6.00	29.93	82.4	1.10	29.94	79.6	2.10	29.96	81.4	40.50
1874	29.98	84.3	2.30	29.97	84.8	2.85	29.90	84.3	9.60	29.88	83.4	4.30	29.91	81.8	3.85	29.94	79.8	3.55	29.94	81.7	39.60
1875	29.99	83.2	3.10	29.94	85.1	5.20	29.94	85.6	4.60	29.92	84.3	5.30	29.92	83.0	4.55	29.92	81.0	5.30	29.97	81.6	37.90
1876	29.96	84.3	5.30	29.95	85.2	1.95	29.92	85.3	5.50	29.90	85.2	4.45	29.88	84.5	2.95	29.95	82.7	4.35	29.94	82.2	54.75
1877	29.96	84.3	8.45	29.99	85.7	3.20	29.94	86.4	3.95	29.93	86.4	2.45	29.90	83.5	8.45	29.96	82.0	3.65	29.95	83.4	53.05
1878	29.97	84.5	9.10	29.99	84.2	6.60	29.92	86.3	4.80	29.90	85.1	4.10	29.91	84.6	5.15	29.97	82.0	2.40	29.96	83.3	66.55
1879	29.99	85.0	5.55	29.94	83.9	7.15	29.97	85.9	5.85	29.94	83.7	6.35	29.90	82.4	7.50	30.00	80.7	2.05	29.96	82.6	67.00
1880	30.02	84.4	6.15	29.95	85.4	2.10	29.97	85.9	2.10	29.94	85.9	1.45	29.97	83.4	5.05	29.98	82.1	1.65	29.99	82.4	68.00
1881	30.01	86.0	2.55	29.94	85.7	19.98	29.94	85.9	2.95	29.99	85.8	5.10	29.91	83.8	6.45	29.96	80.4	2.55	29.97	83.3	60.08
1882	30.03	85.4	3.70	30.00	86.5	5.85	29.98	85.2	5.60	29.92	85.0	6.80	29.89	83.0	4.45	29.97	81.9	3.15	29.99	83.0	85.25
1883	.....	.....	4.45	.....	.....	7.20	.....	.....	6.25	.....	.....	4.24	.....	.....	3.96	.....	.....	6.95	.....	.....	57.85
1884	.....	.....	1.50	.....	.....	4.12	.....	.....	4.25	.....	.....	5.15	.....	.....	3.60	.....	.....	5.80	.....	.....	41.79
1885	.....	.....	1.72	.....	.....	6.54	.....	.....	2.54	.....	.....	9.08	.....	.....	7.98	.....	.....	3.64	.....	.....	44.50
1886	.....	.....	7.50	.....	.....	5.50	.....	.....	15.06	.....	.....	5.71	.....	.....	5.63	.....	.....	3.51	.....	.....	59.70
1887	.....	.....	4.25	.....	.....	5.12	.....	.....	5.79	.....	.....	5.00	.....	.....	9.10	.....	.....	2.40	.....	.....	49.50
1888	.....	.....	6.98	.....	.....	8.03	.....	.....	3.64	.....	.....	5.64	.....	.....	1.86	.....	.....	1.65	.....	.....	46.67
1889	.....	.....	3.92	.....	.....	5.02	.....	.....	6.84	.....	.....	5.02	.....	.....	3.46	.....	.....	2.47	.....	.....	60.40
1890	.....	.....	5.60	.....	.....	3.60	.....	.....	5.52	.....	.....	4.76	.....	.....	1.81	.....	.....	4.02	.....	.....	40.44
1891	.....	.....	5.45	.....	.....	7.49	.....	.....	4.98	.....	.....	10.91	.....	.....	7.22	.....	.....	4.26	.....	.....	49.91
1892	30.06	86.0	2.74	29.98	86.8	9.98	29.98	85.9	5.90	29.93	85.8	3.61	29.90	82.2	8.57	29.96	80.9	2.39	30.00	82.6	47.65
1893	29.96	81.6	5.92	29.94	83.0	2.98	29.94	81.6	6.74	29.84	81.0	3.90	29.90	80.3	1.70	29.94	77.6	3.87	29.96	79.9	42.35
1894	30.03	82.0	2.16	29.98	82.8	3.81	29.94	82.4	4.39	29.92	79.8	7.28	29.94	80.0	6.53	29.96	77.7	6.28	29.98	79.6	43.22
1895	30.01	82.5	3.89	29.93	82.7	7.05	29.92	82.0	9.32	29.90	81.6	5.22	29.90	80.5	3.00	29.88	78.3	5.69	29.96	80.4	54.24
1896	30.00	82.3	6.30	29.96	83.4	3.80	29.90	83.4	7.46	29.90	82.6	4.15	29.89	79.4	14.37	29.95	79.4	2.54	29.95	80.6	61.84
1897	29.98	81.7	5.64	30.00	83.6	3.11	30.00	84.0	3.15	29.96	82.6	1.78	29.95	81.1	2.53	29.98	80.3	2.74	29.97	81.0	37.91
1898	29.98	84.3	7.57	29.97	82.8	7.78	29.94	79.6	12.37	29.96	79.4	4.47	29.94	76.8	4.42	30.03	75.8	3.69	29.97	81.2	52.10
1899	30.00	80.6	2.51	29.96	81.0	3.26	29.97	81.2	5.14	29.91	80.6	6.64	.....	.....	.....	.....	.....	.....	30.01	78.6	30.06
Monthly means	30.00	83.1	4.46	29.97	83.8	5.67	29.94	83.9	6.45	29.92	83.3	6.54	29.92	81.9	5.85	29.96	79.9	3.78	29.97	81.3	51.66

than 3°. This discrepancy is, no doubt, largely due to imperfect exposure of thermometer and the unfavorable hours at which the readings were made—9 a. m. and 4 p. m. The highest temperature recorded since the establishment of the United States Weather Bureau station in August, 1898, to the present time, November, 1899, was 89.4°, and the lowest, 65.1°, thus indicating very narrow limits for the absolute range of temperature, the limits of average range being necessarily less. It is also interesting to note in connection with fig. 3, the remarkable regularity in the hourly departures of the temperature for the three months there represented, February, May, and August. These months were selected because February is regarded as the coldest, May the most nearly normal, and August the hottest month of the year. It is quite safe, therefore, to say that the island is perfectly free from sudden and extreme changes of temperature.

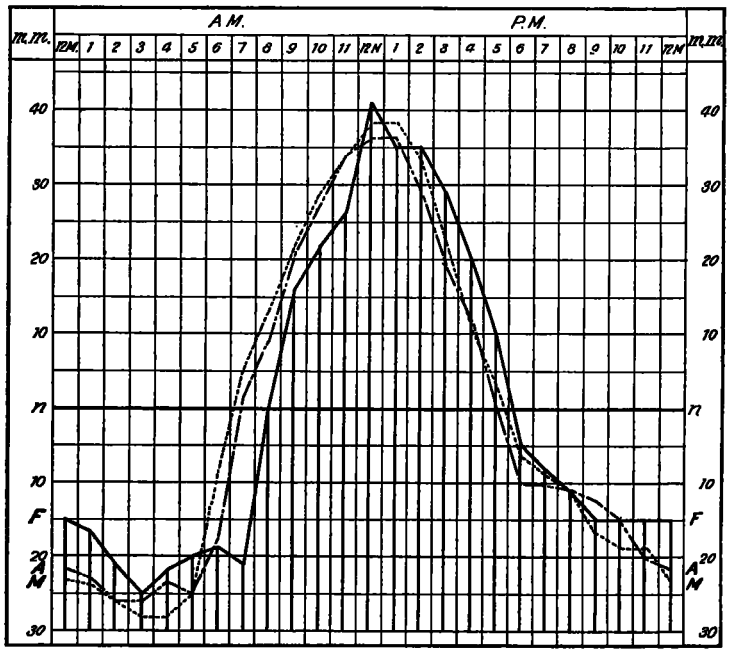

FIG. 3.—Graphic representation of the departures of the hourly from the monthly mean temperature for the months of February, May, and August, 1899. The means are taken from a Richard thermograph. The line *nn* represents the normal, or monthly mean, for February, 75.9°; for May, 79.4°; and for August, 81.0°.

Precipitation (in inches).—The rainfall in St. Kitts is more frequent than heavy, 0.27 inch being the average amount for each day of precipitation. Only eleven times in forty-four years, or once in every four years has the fall reached or exceeded 5.00 inches in twenty-four hours, and only forty-four times in forty-four years, or once a year, has the fall amounted to 2.50 but less than 5.00 inches in twenty-four hours, while the average number of days with 0.01 inch or more is more than 50 per cent of the total for the year. The average precipitation for the month is 4.28 inches and for the year is 51.66 inches. In as much as the records from which these averages were obtained are the records of the rainfall at Basseterre alone, it is probable that they would be altered slightly if the fall at various parts of the island were taken into the count. It is hoped that this point may be treated more fully at some future time. The departures of the monthly means from the normal are clearly shown in fig. 2, while fig. 4 enables one to ascertain the departures of the total annual fall from the normal for the past forty-four years. The precipitation is decidedly least during February and March, while the greatest amount falls in September and October, or, to state it in another way, 37 per cent of the annual fall occurs during the first half of the year and 63 per cent during the last half.

The intimate relation between the rainfall and agriculture justifies the introduction in this connection as a hint along this line, to be followed, perhaps, by a more elaborate discussion. Fig. 4 is an effort to present this relation graphically, but as the curves are based upon data for the calendar year, in order to avoid fallacious deductions this figure must be studied with great care, remembering that the crop for any particular year is afforded only by the rainfall of the preceding year, as for instance, the crop of 1898 is the result of the rainfall of 1897, and so on. It requires at least twelve months to grow and harvest a crop of cane, but as the "crop year" properly begins about the middle of March it does not correspond to the calendar year.

Bearing in mind that the critical period in the history of a cane crop, that is the time at which it is most important to have plenty of rain, is from August to December, more especially October and November, and that very little rain is needed during the harvest months, January, February, and March, it may be readily seen, by glancing at fig. 1, how perfectly the rainfall of the island fulfills these conditions.

The average yield per acre, as given in fig. 4 (1,615 pounds), does not represent the *actual* yield per acre for the reason that it is based upon the number of acres in cane and not not upon the number of acres harvested. Take, for instance, an estate of 500 acres; 200 acres, say, will be in "plant canes" and will form a part of the crop of the following year, while the remaining 300 acres will be harvested this year. Now, the average above mentioned is based upon the entire acreage. The actual average would probably lie between 2,500 and 3,000 pounds per acre.

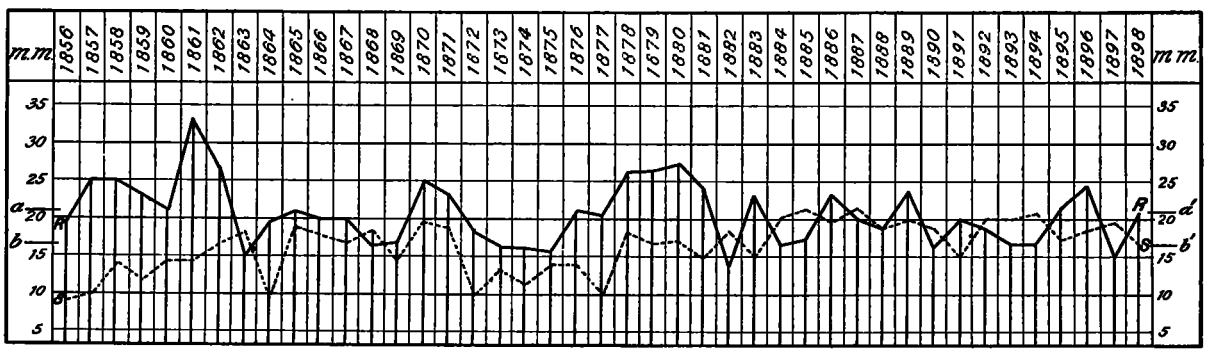

FIG. 4.—*R.* Graphic representation of the total annual rainfall at Basseterre, St. Kitts, W. I., for a period of forty-three years. *S.* The average yield per acre of sugar for the same period. A line drawn from *a* to *a'* would represent the average annual rainfall, 51.66 inches, for the forty-three years, and one drawn from *b* to *b'* the average yield per acre, 1,615 pounds of sugar.

TABLE 2.—*Showing the monthly averages of barometric pressures, temperature, and rainfall at Basseterre, St. Kitts, together with the average number of days on which .01 inch, or more, of rain fell; an average rain (average amount divided by average number of days), and total number of days with 2.50 inches or over. The averages are based on periods of years as indicated at top of each column.*

Months.	Average monthly— Barometric pressure (35 years).	Temperature (35 years).	Rainfall (44 years).	Average No. days with .01 inch or more of rainfall (8 years).	An average rain.	Total No. of days with— 2.50, but less than 5.00 inches of rain (44 years).	5.00 inches or more of rain (44 years).
January	29.99	78.1	3.66	16	.23	1	1
February	30.00	78.3	1.89	14	.14	1	0
March	29.99	78.9	2.07	11	.19	0	0
April	29.98	80.2	3.32	11	.30	5	0
May	29.97	81.5	4.18	15	.28	7	1
June	30.01	82.6	4.00	17	.23	1	0
July	30.00	83.1	4.46	19	.23	2	1
August	29.97	83.8	5.67	18	.32	7	2
September	29.94	83.9	6.45	18	.36	7	2
October	29.92	83.3	6.54	16	.41	7	2
November	29.92	81.9	5.35	16	.33	4	1
December	29.96	79.9	3.78	15	.25	2	1

RAINFALL IN CENTRAL AND WESTERN NICARAGUA.

By EARL FLINT, dated December 18, 1899.

In selecting records of rainfalls I find only three reliable ones, taken at the cities of Masaya, Granada, and Rivas during a period of eleven years, from 1886 to 1896, and giving a mean rainfall of 61 inches and a fraction, including three maximum records at Rivas. The mean fall at the latter city for a period of nineteen years is 68.09 inches, including the abnormal rains in the years 1897 and 1898. I hold the belief that henceforth if records be taken throughout the state the mean fall will be found to be less than 61 inches.

I noted a decrease of the rainfall in 1863, and many old residents had noted the same, which fact was confirmed by the drying of the marshes north of Granada and of the Tipitapa Falls, occurrences not previously remembered. In that year in going around the lake to Talolinga I passed above the outlet of Tipitapa on my way across to Managua. I noticed neither a change in temperature nor a sign of subterranean outflow. What, then, but a slight rainfall would account for the above said decrease? There were no records kept, only the observations made by intelligent citizens. At that time Mr. Espinola brought a rain gage and kept records until 1877. I did not send any complete record until charts and forms were sent for the simultaneous international observations of the Signal Service, now succeeded by those of the Washington Weather Bureau. These I have forwarded complete.

In 1875, during my correspondence with Professor Baird, I again called his attention to the continued closure of the outflow at Tipitapa, which he attributed to a subterranean outlet, while I thought it was due to light rains. Without any records for reference I could only rely on observations of others, aided by personal ones, made on the north and northeast watersheds of Lake Nicaragua. When I went to La Libertad I saw verified the decreased supply that I had foretold, due to deforesting the source of the streams supplying the native arrastras. This water power was soon abandoned for steam power. On the Rivas plateau several small streams which used to run throughout the year are now dry, save in years of maximum rainfall.

In this way I accounted for the great accumulation of detritus at San Carlos, at that time impeding navigation at the entrance of the river. I then asserted to Professor Baird that its continued deposit would within a quarter of a century block the outlet in the dry season, of course counting out the supply of water from Lake Managua, and a diminishing rainfall. The deposit kept on increasing until the outflow at Tipitapa was renewed in 1878. It yet closed again two years between 1881 and 1890. The exact date Mr. J. Vasconcelos, an old resident, could not remember, yet he asserts its closure in 1891 and in 1892, Mr. J. L. Talavera and Mr. William Climie, C. E., confirming the same in 1896.

Should the outlet again close for a series of years, an event more than probable in view of the increasing cultivation along the streams and the sources which now feed the lakes, this would diminish the supply necessary for the proposed canal to connect the lakes and render the canal useless in the dry season, excepting during maximum rainfalls on the watershed. At an early date I suggested the union of the Sebaco rivers so as to increase the supply necessary for the main canal, which supply must, in my opinion, be attended to early, before the augmenting commerce will require more than double the quantity of water necessary when the canal is first finished. This union, according to Mr. Masey, could be done at a small cost.

By replanting the arid plateaus north and east of the lake, selecting trees of the most useful kind, the evaporation already noted would be diminished to at least 50 per cent, it would tend to keep the rivers from drying up to a great extent in the dry season. By this method the object aimed at will be obtained over the country drained by both lakes, that is to say over an area of about 15,000 square miles, much of it mountainous.

If these conservative measures are not adopted we may in a few years see Lake Managua standing below its present outlet as an isolated inland lake.

Judging from past observations we may expect soon to see a repetition of the closure of 1863, since there are this year many corresponding meteorological phenomena: First, the prolonged northeast winds that always check abundant rainfalls, so that now, as then, the crops have suffered in the eastern section of the state; second, in 1861 fell the heaviest rainfall since 1825, thus allowing a large lake steamer to come up from Greytown in two and a half days, passing all the rapids with ease. The year 1899 has been preceded by the maximum of 1897 and 1898, the two greatest in twenty years, the latter nearly double that at Tipitapa, whose light outflow this year is due to *excessive* rainfalls about the head of the lake, yet we fear its closure in 1900 for a series of years as in 1863.

TABLES OF DEW-POINT OBSERVED AT HONOLULU.

By CURTIS J. LYONS, dated August 19, 1899.

In communicating the following tables of dew-point, Mr. Lyons says:

I would venture to suggest that one enter the humidity tables with the average temperature of the month and the average dew-point and take out the required average humidity. For instance, San Francisco, with a mean temperature of 55.1° and a mean dew-point of 47.5° for 1897 (see Annual Report of the Weather Bureau), would have a mean relative humidity of 74.5°, whereas the published mean is 79.5° from the mean of the 8 a. m. and 8 p. m. observations. The humidity at Honolulu derived from 9 a. m. and 9 p. m. local observations and verified by the method above mentioned is 72 per cent. I have found the above method to generally give about the same result for the same hours, and for this reason I have used the above hours (9 a. m. and 9 p. m., local time) for the past eight years.

The dew-point here is an important item in endeavors to predict weather changes. A fall of the dew-point during trade-wind weather is almost always followed within from twenty-four to thirty-six hours by showers, not cyclonic rains, but the common trade-wind shower, is probably caused by the interpenetration of northerly upper currents. Probably the northern currents are caused by distant lows passing north of this place.

[The annual mean temperature of 55.1° used by Mr. Lyons in the example above cited was derived from the daily extremes and differs by 1.3° from the annual mean derived from observations at 8 a. m. and 8 p. m. Entering the humidity